Robotic Repair Technique Targets Fuel Pool Liners

EPRI is collaborating with EDF to evaluate a polymer-based repair technique that could be deployed robotically to repair leaks in spent fuel pool liners.

The spent fuel pools used at nuclear power plants are an integral part of safe nuclear plant operation, serving both to shield the radiation and to cool the fuel rods. These pools are lined with ¼-inch thick stainless steel sheets that are welded together and anchored to concrete walls. The potential for leaks from these weld seams is raising concerns and has prompted the development of advanced inspection and repair techniques. In one effort, EPRI and EDF are jointly developing the prototype of an innovative robotized technique that could be used in-situ for in-service repairs.

Fuel pool leaks from the stainless steel liners in spent fuel pools may contain radioactive nuclides such as tritium and strontium-90. These substances could affect the structural integrity of the concrete and the steel reinforcing bars in fuel pools, and potentially contaminate the groundwater.

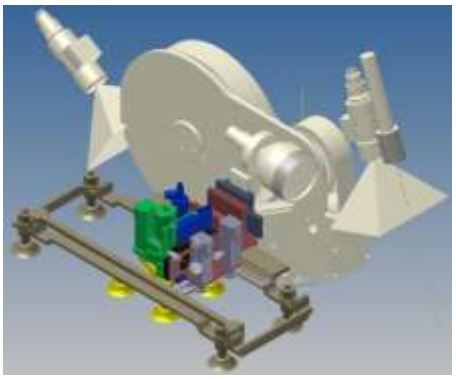
EDF has developed inspection tools to check suspect areas for cracking or leakage from the liner seam welds and from the welds used to attach the liner to the concrete. These tools rely on Alternating Current Field Measurement (ACFM), in which a current is injected locally into the weld, generating an electrical field. The depth and length of identified defects can then be determined through analysis of this data.

Manually applied polymer-based solution

EDF also has been investigating leak repair options and has developed a polymer-based solution that applies a silicone patch in-situ directly on the weld location. This technique, however, requires two manual dives, one to place the tool and inject the silicone into the mold (see photo at right), and a second to disassemble the chassis.

Building on this research, EDF is working with EPRI to develop a robotic delivery system for a metal strip containing a repair polymer. The metal strip would cover the entire weld length (see photo below left), thereby eliminating the need to identify the leak location by inspection. The research goal is to develop and design a metal strip for a 10-year minimum in-service life that could be applied robotically.

General design of a robot able to apply repair strip



Repair strip applied manually on a lap weld

A feasibility study completed in January showed that the repair strip could be successfully applied by a robot in a nuclear environment. The research team has developed the basic design of a robot delivery

system (see figure above right), although a number of details need to be addressed before a fully functional robot is available.

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